WINTER 1980
HIVER 1980

CANADA AGRICULTURE

AGRICULTURE CANADA
CODE 19/03/80 NO.
c5
LIBRARY-BIBLIOTHEQUE

CANADA AGRICULTURE

VOLUME 25 WINTER 1980 No. 1
VOLUME 25 HIVER 1980 Nº 1

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN ____ 3
L'AGRICULTURE ET LA QUALITE DE L'EAU DANS LE BASSIN DES GRANDS LACS ____ 7
WORLD FOOD COUNCIL MEETS IN OTTAWA ____ 11
FILBERT FERTILIZING BY LEAF ANALYSIS ____ 13
SILAGE ADDITIVES ____ 15
ASSISTING THE CANADIAN SEED CORN INDUSTRY 18
SHEEP BREEDING YEAR-ROUND ____ 20
SOME CONTEMPORARY ISSUES CONCERNING MEAT AND POULTRY PRODUCTS ____ 23
WEATHER AND FARM FIELD WORK ____ 26
HALF CENTURY OF FOOD PROCESSING RESEARCH AND DEVELOPMENT AT SUMMERLAND ____ 29
ECHOES/ECHOS ____ 31

CANADA AGRICULTURE is published quarterly to inform extension workers and agribusinessmen of developments in research and other federal agricultural responsibilities.

Any article may be reproduced without special permission provided the source is given credit. If excerpts only are to be used, authors' permission should be obtained.

Reprinted articles must not be associated with advertising material. The use of trade names published in this journal implies no endorsement of the products named nor any criticism of similar products not mentioned.

Contributors may submit articles in either English or French to the Secretary, Editorial Board, Information Services, Agriculture Canada, Ottawa K1A 0C7.

La revue trimestrielle *CANADA AGRICULTURE* renseigne les vulgarisateurs et représentants du négoce agricole sur les développements de la recherche et des autres services agricoles du gouvernement fédéral.

La reproduction des articles est permise en indiquant l'origine. Pour reproduire des passages d'un article, l'autorisation de l'auteur est nécessaire.

Les articles reproduits ne doivent pas servir à des fins de réclame. La mention de marques de fabrique ne signifie pas que la revue garantit ces produits ni qu'elle déconseille d'autres produits non mentionnés.

Les articles en anglais ou en français doivent être adressés au secrétaire du Comité de rédaction, Services de l'information, Agriculture Canada, Ottawa K1A 0C7.

Agriculture Canada

COVER
Surface runoff erodes fields, and transports sediment, nutrients and pesticides.

COUVERTURE
Le ruissellement de surface cause l'érosion des champs, transporte les sédiments, les éléments nutritifs et les pesticides.

MINISTER, MINISTRE
HON. JOHN WISE

DEPUTY MINISTER, SOUS-MINISTRE
GAÉTAN LUSSIER

EDITORIAL BOARD
COMITÉ DE RÉDACTION

G. M. Carman *Chairman/Président*
J. W. Morrison
J. F. Frank
D. F. Kirkland
F. E. Payne
J. T. Phalen *Secretary/Secrétaire*

Editor-Writer/Rédacteur
J. T. Phalen

Production
B. Behne

Graphic Design/Graphique
A. J. McAllister
M. N. McKinney

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN

D. R. COOTE

For some years the Great Lakes have been deteriorating because of pollution. The primary problems appear to be eutrophication (over-enrichment with nutrients) and the presence of toxic materials which degrade the environment generally and may make fish unfit for consumption. In certain instances, sediment is also a problem due to silting of harbours. As well as the known "point sources" such as sewage treatment plants and industries, run-off from the land has also been suspected of causing pollution. Consequently, in 1972 the International Joint Commission (IJC) established the Pollution from Land Use Activities Reference Group (PLUARG) to determine the extent to which this occurred.

As part of the PLUARG studies, Agriculture Canada researchers joined forces with the Ontario Ministries of the Environment and Agriculture and Food to study the impact of agriculture on water quality. Field studies were conducted between 1974 and 1977 in 11 small agricultural watersheds in Southern Ontario. These studies involved approximately 35 government, university and consultant researchers. The results of this integrated effort have been summarized, and the highlights are discussed here.

Eutrophication and sediment are problems that can be considered together because phosphorus is the "limiting" element in the algal growth which results from eutrophication, and most phosphorus from rural areas is attached to sediment. The agricultural watersheds studied were responsible for a wide range of inputs of "total phosphorus" to streams. One watershed contributed no more than 0.2 kg P/ha/yr, while another yielded over 1.5 kg P/ha/yr. Sandy soils and soils used for cereal crops, pasture and woodland generally produced low levels of phosphorus and sediment pollution, while clay soils and intensive row-crops were associated with higher levels. Mathematical estimates indicated that agricultural land contributed about 60% of the total "diffuse tributary" load of phosphorus (excludes point sources) delivered to the Great Lakes from the Canadian side of the basin in 1976. In total, agricultural land contributed about 25% of the phosphorus load to the Lakes from all sources.

The erosion and transport of soil particles, with their associated phosphorus, was responsible for the bulk of the total phosphorus pollution from farmland. In the watersheds studied, sediment entered streams at rates which ranged from 50 to 1000 kg/ha/yr. This stream load was, on average, about 10% of the total soil erosion estimated to have occurred on fields within these watersheds. However, the erosion process was found to be a selective one in which the fine soil particles

(which transport most phosphorus) were those most likely to reach streams.

Are fertilizers and manures responsible for agricultural phosphorus pollution? Since soil materials were found to contain up to 2500 kg/ha of phosphorus in the top 17 cm, it can be seen that if fertilizer and manure phosphorus is well mixed with the soil, where it becomes "fixed", the average annual application (about 21 kg P/ha/yr in the study watersheds) did little to enrich the total soil phosphorus content. Nevertheless, 10% to 50% of the stream "total phosphorus" was in the soluble-reactive form and this was found to be indirectly related to the use of phosphorus in fertilizer and manures. The potential was therefore demonstrated for excessive or poorly managed fertilizer and manure use to increase dissolved phosphorus levels in streamwater while not contributing greatly to the total phosphorus carried by streams.

It is important to know what role livestock play in phosphorus pollution. Détailed studies involving air photos, a mathematical model and field monitoring concluded that each average "animal-unit" (approximately 400 kilograms live weight) resulted in the addition of about 0.15 kg P/yr to streams in the Canadian Great Lakes Basin. In total, this represents about 10% of the estimated phosphorus load from agriculture in the Canadian part of the Basin. Beef feedlots appeared to have the greatest potential for stream pollution from livestock.

HEAVY METALS PLUARG was concerned that agricultural land might be a source of heavy metals in the Great Lakes. Among the many heavy metals which can be found in the Great Lakes, lead and mercury have been identified as potential problems; and arsenic, cadmium and selenium may have potential to become problems at some future date These heavy metals were detected intermittently in the agricultural watersheds at the very low levels associated with natural geologic weathering. In addition to natural weathering, atmospheric deposition and the use of sewage sludge were other possible sources of these heavy metals. Atmospheric deposition of lead on the agricultural watersheds appeared to be higher, in fact, than the losses from them in stream water. Urban and industrial areas and automobiles are sources of atmospheric lead. Copper and zinc, which are unlikely to cause problems, were the only heavy metals detected with sufficient consistency to permit stream loads to be calculated. Phosphate fertilizers were considered a possible source of these two elements but it was found that, at normal fertilizer rates, it would take over 100,000 years to double the present average concentrations in the soil, assuming no losses. Compared with atmospheric input, and sources such as sewage and industrial sludge disposal on farmland, fertilizer contributions of these metals appeared to be negligible.

Sediment from farmland was found to influence trace element levels in streams in the same way as it affected phosphorus loads. Solving the sediment problem would therefore reduce the present loads of heavy metals entering streams from agricultural land to levels even closer to those expected from natural geologic weathering and erosion.

PESTICIDES As anticipated, agricultural runoff contained residues of the persistent organochlorine (DDT type) insecticides which are no longer used but, nevertheless, are of concern to limnologists and wildlife specialists. These materials still remain in soils and stream sediments from their use prior to their discontinuation in the early 1970s. They move with eroded sediments, and can now be controlled only by preventing soil erosion and sediment movement.

Currently permitted non-persistent insecticides (such as chlorpyrifos) showed up only occasionally in the stream water of the agricultural watersheds, and were attributed to accidental spills and careless equipment cleaning and container disposal. They did not appear to persist long enough to be transported to the lakes.

Among the herbicides in use today, the most frequently detected was atrazine which controls weeds in corn. It was found consistently in the stream water of the watersheds in which it was used. Although atrazine was persistent enough to reach as far as the Great Lakes, deleterious effects have yet to be found on wildlife or fish and other aquatic organisms. Nevertheless, the situation justifies continued observation. Other herbicides, such as 2,4-D, were detected only intermittently and were often associated with road and ditch bank spraying.

INDUSTRIAL ORGANIC TOXICANTS Somewhat surprisingly, the industrial organic toxicant PCB (polychlorinated biphenyl) was detected regularly in all of the agricultural watersheds. It was present in rainfall and no source could be found other than the atmosphere. PCB accumulates in fish, birds and human beings, and is known to cause deformities and reproductive failure in

Eleven agricultural watersheds (•) were studied in the agricultural portion of the Canadian Great Lakes Basin.

fish-eating birds. It is just one of a number of industrial compounds which may have dangerous effects on the environment (eg. Mirex, HCB). Its presence in agricultural runoff water is of concern, but it appears certain that it does not come from agricultural activities.

Nitrate and pathogenic bacteria are other contaminants which may affect human health. The use of nitrogen in fertilizers and manures was found to be contributing nitrate to streams and was suspected of contaminating groundwater — as also was nitrogen lost from the natural decomposition of soil organic matter which is accelerated by intensive cultivation. While nitrate does not appear to cause a water quality problem in the Great Lakes, its presence in streams and groundwater, occasionally at levels exceeding the generally recognized safe drinking water standard (10 mg/L as N), should be of concern to public health authorities and to farmers who rely on these sources for their water supply.

Certain bacteria can be an indication of stream contamination by faecal matter with the consequent potential for disease transmission. Bacteria are derived from many sources including livestock, runoff from barn lots and manure storages, manure spreading, wildlife, faulty septic tanks, and even natural soil and stream conditions. All of the above sources appeared to be contributing to the bacteria found in the agricultural watersheds, sometimes

at fairly high levels (exceeding recreational water standards). Bacteria numbers are so variable and dynamic in stream water that they could not be related to the levels found in the Great Lakes.

Control measures are important. It has become apparent, through lake modelling studies, that some form of diffuse-source phosphorus control is going to be necessary in the drainage basins of Lakes Erie and Ontario and parts of Lake Huron. How can agriculture reduce its contribution to phosphorus pollution of these lakes?

A major portion of diffuse phosphorus inputs can be controlled by reducing the entry of eroded soil into streams. Soil erosion control should be one of the chief methods considered to reduce agricultural contributions of total phosphorus to streams leading to these lakes. Sediment reduction also has the advantage of reducing the movement of pesticides and heavy metals. A number of measures might be adopted by farmers, at essentially no cost, to reduce the sediment and pollution problem. In areas contributing runoff into streams most frequently (i.e. near streams and ditches, and where fine-textured soils are cultivated up and down the slope for wide-spaced row crops) farmers could do some or all of the following:

- retain surface residues through the winter months as a mulch;
- use the minimum amount of tillage necessary for the crop;
- apply phosphorus fertilizer only as indicated by soil test;
- plow manure under as soon as it is applied (not use manure at all adjacent to streams and ditches);
- maintain soil organic matter levels by maximizing the amount of crop residues returned to the soil;
- perform field operations across the slope.

In addition to these "good management" practices which cost little or nothing, various combinations of crop rotations, using winter cover crops (e.g. oats), strip cropping, leaving "buffer strips" along stream channels and improved drainage outlets could achieve further reductions in phosphorus and sediment pollution — but these do involve a cost to the farmer. All of the above, however, may be of long-term benefit to farm productivity. It has been estimated that up to 35% of the agricultural phosphorus contribution to the Canadian Great Lakes Basin might be controllable. Many factors influence the selection of feasible remedial practises. The soil types, slopes, existing cropping and livestock activities, farm economic status and market for crops not currently grown will all affect the acceptability, cost and effectiveness of control measures. The alternatives must, therefore, be carefully evaluated on a site by site basis.

Measures can be considered for the control of other pollutants from agriculture, though they are not yet needed from a Great Lakes water quality standpoint. For example, nitrogen fertilizer rates and timing can be better matched to crop uptake, and fall cover-crops can be used to reduce nitrogen leaching. Application rates of atrazine can be reduced near streams, and less persistent materials substituted, especially where needed to preserve vegetated waterways and buffer strips. Some materials, such as certain heavy metals and PCB, are beyond the control of agriculture as they are of natural or external origin. Nevertheless, these materials can be retained on the land by measures designed to reduce sediment movement.

Agricultural Watershed Studies in the Canadian Great Lakes Basin have demonstrated that agricultural land is responsible for a considerable portion of the phosphorus and sediments entering the Great Lakes from "diffuse" sources. Some of this input, depending on the location, soils and farming type, can be controlled by improved farm management techniques and by other specific measures of varying effectiveness and of varying cost. However, a large portion of the existing input of phosphorus and sediment to streams from agricultural land will still continue — unless drastic measures are taken that would likely change agriculture entirely from the way it is presently practised. Such a course of action would likely be unacceptable to most spheres of society. Nevertheless, it is important that farmers realize their current role in water pollution. They can demonstrate their concern by adopting management alternatives which will reduce current stream loadings of pollutants.

The program discussed here was funded jointly by Agriculture Canada, the Ontario Ministry of Agriculture and Food, and the Ontario Ministry of the Environment in support of the International Reference Group on Great Lakes Pollution from Land Use Activities. Opinions expressed are those of the author and do not necessarily reflect the recommendations of the Reference Group.

The author wishes to acknowledge the contributions of all the scientists and technicians involved in this extensive integrated study.

Dr. Coote is a Research Scientist, Land Resource Research Institute, Agriculture Canada, Ottawa.

L'AGRICULTURE ET LA QUALITÉ DE L'EAU DANS LE BASSIN DES GRANDS LACS

D. R. COOTE

Depuis quelques années, la pollution a entraîné une dégradation de la qualité de l'eau des Grands Lacs. Les principaux problèmes semblent être l'eutrophisation (sur-enrichissement en éléments nutritifs) et la présence de substances toxiques qui altèrent la qualité du milieu et rendent les poissons impropres à la consommation. La formation des sédiments crée également des problèmes dans certains cas, car elle provoque l'envasement des ports. Tout comme les «sources ponctuelles» connues, les industries et les stations de traitement des eaux usées par exemple, les eaux de ruissellement ont également été considérées comme des causes éventuelles de pollution. Par conséquent, pour déterminer l'importance exacte de la contamination par ces dernières sources, la Commission mixte internationale (CMI) a créé, en 1972, le Groupe d'études sur la pollution causée par les activités liées à l'utilisation des terres (PLUARG).

Dans le cadre des travaux du PLUARG, les chercheurs d'Agriculture Canada, de concert avec des représentants des ministères ontariens de l'Environnement, et de l'Agriculture et de l'Alimentation ont entrepris des études sur les effets des activités agricoles sur la qualité des eaux. Entre 1974 et 1977, ils ont effectué des recherches sur le terrain dans onze petits bassins hydrographiques agricoles du sud de l'Ontario. Ces travaux, effort concerté de près de 35 chercheurs conseils et représentants des gouvernements et des universités, ont été résumés dans une autre publication et le présent article en expose les grandes lignes.

L'eutrophisation et la formation des sédiments peuvent être étudiés ensemble parce que d'une part le phosphore est l'élément «limitant» de la croissance des algues qui résulte de l'eutrophisation et que d'autre part, la majeure partie du phosphore provenant des régions rurales est liée aux sédiments. Les quantités de phosphore totales déversées dans les cours d'eau par les bassins étudiés couvrent un large éventail de valeurs allant de 0,2 kg de P/ha/an dans un cas à plus de 1,5 kg de P/ha/an dans un autre. D'une façon générale, le degré de pollution par le phosphore et les sédiments est moins élevé dans les zones de sols sableux ou dans les régions sous emblavures, pâturage et forêt contrairement aux zones de sols argileux et de cultures intensives en ligne. Des estimations mathématiques révèlent qu'en 1976, 60% de la quantité totale de phosphore déversée dans les Grands Lacs par les tributaires dispersés (sources ponctuelles exceptées) du côté canadien du bassin hydrographique provenaient des terres agricoles. Au total, ces dernières ont contribué environ 25% de la charge totale déversée par toutes les sources.

L'érosion et l'entraînement des particules de sol liées au phosphore constituent les principaux agents de la pollution par le phosphore provenant des terres agricoles. Dans les bassins hydrographiques étudiés, les sédiments s'accumulent dans les cours d'eau au rythme de 50 à 1000

kg/ha/an, soit en moyenne près de 10% de l'érosion totale des champs de ces bassins. Toutefois, ce phénomène se produit de façon sélective, les fines particules de sol (celles qui transportent la majeure partie du phosphore) atteignant plus sûrement les cours d'eau.

Quel rôle jouent les engrais et le fumier dans la contamination par le phosphore? La couche supérieure de 17 cm de sol renfermant jusqu'à 2500 kg de P/ha, si le phosphore de l'engrais ou du fumier est bien incorporé au sol où il est «fixé», les doses moyennes appliquées annuellement (environ 21 kg de P/ha/an dans les bassins hydrographiques étudiés) ne contribueront donc que très peu à l'enrichissement total du sol en phosphore. Néanmoins, de 10 à 50% du phosphore total se retrouvent sous forme soluble dans les cours d'eau, ce qui résulterait indirectement, croit-on, de l'utilisation d'engrais et de fumier phosphorés. On en a donc déduit qu'une fertilisation abusive ou mal dirigée entraîne une hausse des teneurs en phosphore soluble dans les cours d'eau sans toutefois contribuer grandement à une augmentation des quantités de phosphore total qu'ils véhiculent.

Le rôle des élevages dans la contamination des eaux par le phosphore mérite absolument d'être déterminé. Des études approfondies mettant en œuvre des photographies aériennes, un modèle mathématique et des travaux de terrain ont permis de conclure qu'en moyenne chaque unité animale (pesant environ 400 kg) déverse à peu près 0,15 kg de P/an dans les cours d'eau du bassin canadien des Grands Lacs. Cette valeur représente au total près de 10% de la charge approximative de phosphore due aux activités agricoles dans la partie canadienne du bassin, les parcs d'engraissement de bovins formant, potentiellement, la source la plus «polluante».

MÉTAUX LOURDS Le PLUARG craignait que les métaux lourds trouvés dans les Grands Lacs ne proviennent des terres agricoles. Parmi les nombreux métaux lourds qui s'y retrouvent, le plomb et le mercure présentent des risques potentiels et il pourrait en être de même de l'arsenic, du cadmium et du sélénium dans un avenir rapproché. Ces éléments, décelés de façon intermittente dans les bassins hydrographiques agricoles, n'atteignent que les très faibles teneurs résultant habituellement de l'altération géologique naturelle. Les autres sources possibles seraient l'entraînement au sol des polluants atmosphériques et l'utilisation des boues usées. L'entraînement des particules de plomb de l'atmosphère vers le sol des bassins semble en réalité s'effectuer beaucoup plus rapidement que le lessivage par les cours d'eau. Le plomb est libéré dans l'air par les véhicules automobiles et les zones urbaines et industrielles. Le cuivre et le zinc, potentiellement peu dangereux, sont les seuls métaux lourds qui se retrouvent assez régulièrement dans les cours d'eau pour que les charges introduites puissent être calculées. Ils proviennent tous deux probablement des engrais phosphatés mais, des essais ont permis de conclure, qu'avec des applications de doses normales d'engrais, il faudrait plus de 100 000 ans pour doubler les concentrations moyennes actuelles dans le sol, en supposant qu'il ne se produise aucune perte. Cet apport serait donc négligeable comparativement aux quantités entraînées de l'atmosphère vers le sol ou issues de sources comme les eaux usées ou les décharges de boues industrielles sur les terres agricoles.

Comme dans le cas du phosphore, les sédiments arrachés des terres agricoles influent sur les teneurs des cours d'eau en éléments mineurs. En prévenant leur formation, on réduirait les charges actuelles des cours d'eau en métaux lourds à des niveaux encore plus près de ceux obtenus suite à l'érosion, aux conditions géologiques naturelles et à la température.

PESTICIDES Comme prévu, les eaux de ruissellement des zones agricoles renferment des résidus d'insecticides organo-chlorés rémanents (type DDT) qui, bien que n'étant plus utilisés, inquiètent les limnologues et les spécialistes de la faune. Les résidus de ces insecticides dont l'emploi a été interdit au début des années 1970, persistent encore dans les sols et les sédiments. Ils sont véhiculés par les débris d'érosion, et actuellement la seule façon de contrer leurs effets est d'éviter l'érosion du sol et le transport des sédiments.

Les insecticides non rémanents (chlorpyrifos) dont l'usage est permis actuellement se retrouvent occasionnellement dans les cours d'eau des bassins hydrographiques agricoles, et leur présence a été imputée à des déversements accidentels, à la négligence durant le nettoyage de l'équipement et au rejet des contenants dans les cours d'eau. Cependant, ils se dégraderaient avant d'atteindre les lacs.

Parmi les herbicides en usage aujourd'hui, celui qu'on décèle le plus souvent dans l'eau est l'atrazine employé pour lutter contre les mauvaises herbes des cultures de maïs. Il se retrouve régulièrement dans les cours d'eau des bassins où il a été appliqué et bien qu'il soit

Onze bassins hydrographiques agricoles (•) ont été étudiés dans le bassin canadien des Grands Lacs.

assez persistant pour atteindre les Grands Lacs, jusqu'ici aucun effet délétère sur la faune, les poissons ou d'autres organismes aquatiques n'a été constaté. Toutefois, la situation justifie une surveillance constante. D'autres herbicides comme le 2,4-D n'ont été décelés que de façon intermittente, et leur présence a été souvent imputée à l'aspersion du bord des routes et des fossés.

TOXIQUES ORGANIQUES INDUSTRIELS Il est quelque peu surprenant que le PCB (polychlorobiphényle), toxique organique industriel, se retrouve régulièrement dans tous les bassins hydrographiques agricoles étudiés. Il se retrouve dans les eaux de pluie, et on n'a pu trouver aucune autre source que l'atmosphère. Le PCB s'accumule chez les poissons, les oiseaux et les êtres humains et provoque des déformations et des troubles de la reproduction chez les oiseaux prédateurs des poissons. Il ne s'agit là que d'un des nombreux produits industriels qui peuvent avoir des effets nocifs sur l'environnement (Mirex, HCB). Sa présence dans les eaux de ruissellement des zones agricoles est inquiétante, mais il semble certain qu'il ne provient pas d'une source agricole.

Les nitrates et les bactéries pathogènes sont d'autres types de contaminants qui peuvent avoir des effets nocifs sur la santé de l'homme. On a observé que l'azote des engrais et du fumier contribue à la contamination par les nitrates des cours d'eau et probablement des eaux souter-

raines tout comme l'azote résultant de la décomposition naturelle de la matière organique du sol, décomposition qui est accélérée dans les régimes de culture intensive. Si la contamination de l'eau des Grands Lacs par les nitrates ne constitue pas un problème, leur présence dans les cours d'eau et les eaux souterraines, parfois à des teneurs dépassant les quantités admissibles dans l'eau potable (10 mg/1, en N) devrait inquiéter les responsables des services sanitaires et les agriculteurs qui s'approvisionnent à ces sources.

La présence de certaines bactéries peut dénoter une contamination des cours d'eau par les matières fécales, contamination qui s'accompagne de risques de propagation de maladies. Elles proviennent de nombreuses sources dont le bétail, les eaux de ruissellement s'écoulant près des étables et des stocks de fumier, le fumier épandu, la faune, les fosses septiques défectueuses ou encore de substances naturelles du sol et des cours d'eau. Toutes ces sources contribueraient à la contamination bactérienne des bassins hydrographiques agricoles, parfois à un degré relativement élevé (les teneurs dépassant les normes prescrites pour les eaux des zones récréatives). Le nombre de bactéries dans les cours d'eau est tellement fluctuant qu'on n'a pu établir de relation entre sa valeur et les quantités trouvées habituellement dans les Grands Lacs.

Des travaux de modélisation ont révélé qu'il faudra bientôt établir une certaine forme de contrôle des sources «dispersées» de phosphore dans les bassins hydrographiques des lacs Erié et Ontario et d'une partie de celui du lac Huron. Comment réduire l'apport de phosphore dans ces lacs par les activités agricoles?

Une forte proportion des quantités de phosphore émises par les sources dispersées disparaîtrait en limitant l'apport de débris d'érosion dans ces cours d'eau. Le contrôle de l'érosion serait le principal outil dont disposerait le secteur agricole pour réduire la quantité de phosphore total qu'il déverse dans les tributaires de ces lacs. Il offre aussi l'avantage de restreindre le mouvement des pesticides et des métaux lourds. Dans cette optique, un certain nombre de mesures, n'occasionnant aucun frais, s'offrent aux agriculteurs pour pallier le problème des sédiments et de la pollution. Dans les zones de ruissellement le plus intense (près des cours d'eau et des fossés et dans les zones de sol à texture fine cultivées en lignes largement espacées, parallèlement à la pente) les agriculteurs devraient appliquer, en tout ou en partie, les mesures suivantes:

- accumuler les résidus laissés sur la terre au cours des mois d'hiver en guise de paillis;
- ne pratiquer que la somme minimale de labours nécessaire à la culture;
- n'appliquer que les doses d'engrais phosphaté déterminées par l'analyse des sols;
- enfouir le fumier dès qu'il a été apporté au champ (ne pas en épandre près des cours d'eau et des fossés);
- maintenir les teneurs en matière organique du sol à un niveau approprié en restituant des quantités maximales de résidus de récolte au sol;
- cultiver dans le sens contraire de la pente.

A côté de ces pratiques judicieuses qui ne coûtent presque rien, d'autres solutions s'offrent à l'agriculteur pour réduire les effets de la pollution par les sédiments et le phosphore, quoiqu'elles exigent certains déboursés de sa part. L'utilisation de diverses combinaisons de rotations de culture, incorporant une culture d'hiver (avoine par exemple), l'alternance des bandes, en ménageant des «bandes tampons» le long du lit des cours d'eau et l'amélioration des voies de drainage. Toutefois, à long terme, ces mesures contribueront à accroître la productivité agricole. On estime qu'il serait possible de réduire de 35% l'apport de phosphore dû aux activités agricoles dans le bassin canadien des Grands Lacs. De nombreux facteurs influent sur le choix des mesures curatives applicables. L'attrait, le coût et l'efficacité d'une mesure de protection dépendront des types de sol, de pente, d'élevage et de culture en place, de la situation économique de la ferme et de l'existence de débouchés pour les variétés végétales non cultivées actuellement.

Les solutions de rechange devront donc être rigoureusement évaluées en considérant chaque cas en particulier.

Certaines mesures permettent de réduire les concentrations des autres polluants résultant des activités agricoles même s'ils ne contribuent pas encore à la dégradation de la qualité des eaux des Grands Lacs. Par exemple, les doses et le calendrier d'application des engrais azotés peuvent être adaptés au rythme d'assimilation par les récoltes ou encore une culture d'automne peut être implantée pour réduire le degré de lessivage de l'azote. Par ailleurs, les doses d'application de l'atrazine seront diminuées près des cours d'eau et des produits moins persistants lui seront substitués, en particulier pour protéger la végétation des rives des voies d'eau et les

bandes «tampons». Quelques substances, comme certains métaux lourds et le PCB échappent au contrôle des agriculteurs, car elles proviennent de sources naturelles ou extérieures. Toutefois, on peut limiter leur sphère de propagation aux terres en contrôlant le transport des sédiments.

Les études sur les bassins hydrographiques agricoles du bassin canadien des Grands Lacs ont révélé que les terres agricoles comptent parmi les principales sources «dispersées» de phosphore et de sédiments véhiculés dans les Grands Lacs. Selon la situation géographique, le type de sol et d'exploitation agricole, cet apport peut être réduit en partie en améliorant les techniques de gestion agricole et en appliquant d'autres mesures spécifiques dont l'efficacité et les coûts diffèrent. Cependant, les entreprises agricoles continueront à déverser une forte proportion de ces quantités de phosphore et de sédiments dans les cours d'eau, à moins que des moyens énergiques ne soient pris pour transformer éventuellement en profondeur les pratiques agricoles d'aujourd'hui. Ces mesures ne plairont probablement pas à certaines sphères de notre société. Toutefois, les agriculteurs doivent prendre conscience de leur rôle dans la dégradation de la qualité des eaux et montrer qu'ils y sont sensibilisés en adoptant d'autres méthodes de gestion afin de réduire les quantités de polluants déversés dans les cours d'eau.

Le programme décrit dans cet article a été financé par Agriculture Canada, le ministère ontarien de l'Agriculture et de l'Alimentation, le ministère ontarien de l'Environnement pour aider le PLUARG. Les opinions émises dans le présent article n'engagent que l'auteur et ne traduisent pas nécessairement les recommandations du PLUARG.

L'auteur tient à remercier tous les scientifiques et techniciens qui ont participé à cette étude exhaustive.

M. Coote est chercheur scientifique à l'Institut de recherches sur les terres, Agriculture Canada, Ottawa.

WORLD FOOD COUNCIL MEETS IN OTTAWA

SANDRA KELLY O'HARA

La cinquième session ministérielle du Conseil mondial de l'alimentation, organisme des Nations Unies attaché à la politique alimentaire, s'est tenue à Ottawa du 4 au 7 septembre. Le Premier ministre a officiellement ouvert la session à la Chambre des communes.

Le ministre de l'Agriculture, John Wise, chef de la délégation canadienne, a annoncé la création d'un fonds de deux millions de dollars en vue d'aider les pays en développement à établir une stratégie alimentaire à long terme; la contribution du Canada pour l'année 1980 d'une somme de 5,5 millions de dollars au Fonds international des réserves alimentaires d'urgence; et la décision de négocier une nouvelle convention d'aide alimentaire, indépendante d'une nouvelle convention internationale sur le commerce du blé. Aussi, le Canada fournira annuellement 600 000 tonnes de céréales en aide alimentaire, en vertu de la Convention d'aide alimentaire.

Le président du Conseil mondial de l'alimentation a fait l'éloge du Canada pour ses initiatives et a exprimé l'espoir que cette attitude incitera les autres pays développés à apporter une aide semblable.

The 36-nation World Food Council, created in 1974 on the recommendation of the World Food Conference, held its Fifth Ministerial Session in Ottawa, September 4-7. Federal Agriculture Minister John Wise headed the Canadian delegation to the conference.

Mr. Wise pointed out that Canada, in its own agricultural policy, was putting a good deal of emphasis on improving an effective and integrated food system for Canada. He said that each developing country should give priority to an agricultural policy that would stress creation of a national food sector strategy and announced that Canada will set

aside a special fund of $2 million to assist developing countries to prepare long-term national food sector strategies for the 1980s. Mr. Wise announced that for 1980 Canada would make a contribution of $5.5 million to the International Emergency Food Reserve set up in 1975 to deal, through the World Food Program, with emergency situations due to man-made or natural disasters in developing countries.

Canada also announced its decision to negotiate a new Food Aid Convention separately from a Wheat Trade Convention but related to an International Wheat Agreement, and its intention to provide 600,000 tonnes of grain annually to the new Food Aid Convention. (Negotiations aimed at a new International Wheat Agreement adjourned last February without agreement being reached.)

Prime Minister Joe Clark, in his speech at the opening ceremonies, said that Canada's current contribution to agricultural and rural development would be maintained. He said that a truly major effort to eradicate hunger, with its human degradation and despair, is a political imperative for building cooperation and solidarity among all peoples and nations.

In urging governments to ensure a fair return to the producer, he said, "Producers the world over can be counted on to produce a constant supply of food to consumers at reasonable prices provided they can be assured a fair return for their investment and efforts."

Both Mr. Clark and Mr. Wise called for a greater emphasis on the role of fisheries in meeting the protein requirements of all countries.

Documents prepared for the meeting indicated that there are more hungry people today in the world than ever before; more than a billion people do not get enough to eat to meet their calorie requirements and over 450 million of these are estimated to suffer from serious undernutrition. Every year, in developing countries, 15 million children die from malnutrition and disease.

Council president Arturo Tanco, Agriculture Minister of The Philippines said the group's four-day meeting saw general agreement that food production has to be given top priority in developing countries.

There was also widespread agreement that a new Food Aid Convention providing for at least 10 million tonnes of grain should be negotiated quickly.

"No right is more fundamental than the right to food and no goal more urgent than the goal of overcoming the hunger of a billion people," the council declared in its final report.

One approach that Tanco believes shows promise is the concept of national food sector strategies which would cover problems as diverse as farm credit and nutrition and would focus administrative and political efforts on improving every aspect of the food cycle from farmer to consumer.

The council reaffirmed its belief that the prime responsibility to solve the food problem is with the developing countries themselves, but the support of the international community is necessary. If hunger and malnutrition are to be overcome, the task must be reaffirmed as the common and joint responsibility of developed and developing countries.

Sandra Kelly O'Hara is an editor-writer in Information Services, Agriculture Canada, Ottawa.

FILBERT FERTILIZING BY LEAF ANALYSIS

C. G. KOWALENKO

Des échantillons de tissu ont été prélevés sur les feuilles des aveliniers dans la vallée du Fraser, afin de déterminer de quels éléments nutritifs manquaient le sol. On s'est servi, comme point de départ des recherches, des expériences menées en Oregon sur la production des avelines. Il fallait cependant adapter les recherches aux conditions particulières à la Colombie-Britannique. Les principaux éléments qui n'existaient pas en quantité suffisante dans la composition du sol étaient, d'abord, K en particulier, ainsi que N, P, Ca, Mg et B. On a également trouvé, dans certains cas, une surabondance de N, P et de K. Suite à ces résultats, on a pu décider plus précisément de la nature des fertilisants à utiliser.

Figure 1 Filbert leaf showing visual magnesium (browning between the veins) and potassium (browning at the leaf edges) deficiency symptoms.

The Lower Fraser Valley of British Columbia contains a commercial filbert nut industry which at present comprises about 120 hectares. Some filbert orchard trees are up to 50 years old and are still productive. There is considerable interest in establishing new orchards. Interest arises primarily because this crop can be readily mechanized, yields are fairly consistent and there is considerable market potential.

British Columbia filbert growers have relied heavily on research and grower experience in Oregon. Weather and soil conditions in filbert growing areas of British Columbia are not always comparable to those of Oregon, therefore Oregon management practices are often not suitable for British Columbia conditions. In an effort to assist growers in British Columbia with proper fertilization practices a leaf tissue survey was conducted in the summer of 1978. The survey was intended to examine the current elemental status of the orchards through visual observations and comparison of tissue nutrient levels with nutrient levels reported in the literature.

Seventeen orchards comprising the 120 hectares were sampled. Duchilly is the main cultivar in British Columbia, but Barcelona, the most popular variety in Oregon, is also grown. Orchards range from 2 to 16 hectares and are from 5 to 50 years old. Tree spacings range from 2.6 m x 5.2 m to 6.4 m x 6.4 m resulting in densities ranging between 40 to 121 trees/hectare. The orchards were on seven different soil mapping units. Pruning programs varied as did orchard floor management (either clean cultivation or grass with herbicide and flailing). Fertilizer applications included chemical fertilizers, pig slurry and chicken manure at a variety of rates. The variety of management practices suggests a lack of clearly defined guidelines for orchard management under Fraser Valley conditions.

Leaf tissue samples representing each orchard were taken in late August to early September. Analyses included N, P, K, Ca, Mg, B, Mn, Fe, Zn and Cu. Critical levels for N, P, K, Ca, Mg, B and excessive levels for N, P, K and B have been established for Oregon filbert orchards and were used as the basis for evaluating nutrient levels. Mn, Fe, Zn and Cu deficient levels have not been established.

The main deficiency according to leaf analysis was K, where 11 out of 17 orchards had insufficient levels (Table 1). Instances of N, P, Ca, Mg and B deficiency were found and also several instances of exces-

sive N, P and K fertilization. The low Ca levels in five of the orchards may suggest that the soil pH is low and the soils require liming. In four of the five cases where calcium was apparently deficient, the orchards were young (5 to 7 years) whereas the orchards having higher values were all much older. It may be either that trees that are very actively growing (it takes 10 or more years for the tree to fully mature) have a much higher demand for Ca or that the growers of these young orchards (new to the industry) have not developed a suitable liming program.

Fairly classic visual Mg deficiencies were noted in some filbert trees (Figure 1). Browning in between the veins of the leaf occurred. Browning and curling of the leaf edges appears to be associated with K deficiency. Leaves showing the symptoms illustrated (Figure 1) contained 0.05% Mg and 0.12% K, whereas the orchard sampled as a whole contained 0.20% Mg and 0.76% K. Adequate levels were taken to be 0.20% Mg and 0.90% K. Magnesium deficiency occurred in patches whereas K deficiency was more general in this orchard.

One orchard which did not receive its annual fertilizer application showed purpling of newly developed or developing leaves (Figure 2). The plants in the photograph represent the entire orchard relatively well. Besides the purpling of the young leaves, the older leaves were generally a dull green. Both K and Mg were apparently deficient as shown by leaf chemical analyses and the deficiency symptoms described for these elements appear in the photograph. The levels were not extremely low as was found in several other orchards but these other orchards did not exhibit the purple coloration. N was adequate, P was excessive and Ca and B were deficient. Boron was very low (5 ppm) compared to the currently accepted critical value (30 ppm). The visual symptoms, then, appear to be due to the imbalance of P, Ca and B. Both Ca and B tend to be immobile in the plants and visual deficiency symptoms are often evident at the growing point. The symptoms in the photograph, then, are tentatively attributed to Ca and B deficiencies. This orchard was on a soil high in organic matter which could have contributed to low soil pH which would account for the low Ca and B, and high P.

The status of Mn, Fe, Zn and Cu appeared to be generally adequate in comparison to literature values, but often were at the low end of the values (Table 2). Since Mn, Fe and Zn availabilities decrease as soil pH increases, these micronutrients should be monitored in those orchards that were acidic at the time of leaf sampling and would be subsequently limed.

Leaf tissue analyses for fertilizer recommendations of perennial crops have an advantage over soil analyses since they are much more universally applicable. Many different soil extractions are used in various soil testing laboratories, each of which was calibrated for soil and environ-

TABLE 1. SUMMARY OF NUTRIENT DEFICIENCIES AND EXCESSES IN B.C. FILBERT ORCHARDS AS FOUND BY 1978 LEAF SURVEY

Fertilizer element	Number of orchards	
	Deficient	Excessive
Nitrogen	3	2
Phosphorus	1	6
Potassium	11	1
Calcium	5	0
Magnesium	2	0
Boron	2	0

TABLE 2. CONCENTRATIONS (μg) OF Mn, Fe, Zn AND Cu IN B.C. FILBERT LEAVES COMPARED TO LITERATURE (OREGON) VALUES

Element	Survey samples		Literature values
	Ave	Range	Range
Mn	240	98-569	166-897
Fe	161	95-378	236-529
Zn	20	15-27	18-50
Cu	8	6-13	5-460

Figure 2. Filbert tree showing calcium deficiency symptoms (developed and developing leaves turn purple). Some older leaves show visual potassium (browning at the leaf edges) and magnesium (browning between the veins) deficiency symptoms.

mental conditions of a particular region. Calibrating a tree crop would be very tedious since long-term fertilizer effects must be incorporated into the interpretation. Meaningful soil sampling can be difficult if fertilizer is banded rather than broadcast. Banding of fertilizers is frequently done in filbert production. Leaf tissue analyses, on the other hand, determine directly the nutrient status of the crop.

These results illustrate the benefits of using leaf tissue analyses. Adjustments of current fertilizer practices have been recommended from leaf analyses after one season of data. This could not have been done so objectively or quickly by soil analysis.

Dr. Kowalenko is a soil nutritionist at Agriculture Canada's Research Station, Agassiz, B.C.

SILAGE ADDITIVES

L. J. FISHER

Pour obtenir le meilleur ensilage possible, il s'agit de se rappeler que le fourrage doit avoir suffisamment de glucides solubles afin d'activer la fermentation; qu'il ne doit pas y avoir d'air; et que l'acidification doit se produire le plus vite possible.

Il est impossible d'assurer, lors de l'ensilage, des conditions optimales; c'est pourquoi on a mis au point des additifs qui favorisent les processus requis. On a étudié l'efficacité de ces produits qui peuvent être classés en trois catégories (tableaux 1 et 2). On en a conclu que ces produits n'améliorent pas la qualité de l'ensilage, au contraire, mais qu'ils peuvent toutefois s'avérer utiles lorsque les conditions d'ensilage sont mauvaises.

In order to appreciate the potential role of additives in the making of silage it is necessary to remember the basis of the ensiling process. Silage is a feedstuff resulting from the anaerobic preservation of moist forage crops or crop residues through acidification by fermenta-

A formic acid applicator attached to a forage harvester treating a field crop for ensiling.

tion. Therefore the forage must have sufficient soluble carbohydrate to act as a substrate for fermentation, air must be excluded and acidification should occur quickly. The optimum fermentation or minimum loss of nutrients can be expected to occur when a forage is ensiled at a dry matter percentage of 28-34%, a water soluble carbohydrate content of 6-8% and with rapid filling with firm compaction to exclude air. Conditions suitable for the rapid growth of lactic acid producing bacteria are required for adequate preservation. Physical characteristics of the filling procedure such as fineness of chop, speed of filling, amount of packing and effectiveness of sealing are all related to degree of air exclusion. High quality forage can quickly become a low quality silage if the ensiling technique is inadequate.

It is rarely possible to ensure that optimum conditions exist for proper ensiling of forages and, therefore, additives have been developed to assist the fermentation process. Originally, natural feedstuffs were used as additives. Molasses or grain have been used to provide readily soluble carbohydrate, urea to provide additional nitrogen or alfalfa cubes (Fisher, 1978 Canada Agriculture pp. 21-22) to provide protein and to increase dry matter content.

Strong acids such as a mixture of phosphoric and hydrochloric acids (AIV process) or formic acid have been used successfully to quickly lower the pH and hence improve the quality of preservation of silage. This application of strong acids to high moisture grass silage has proven effective but the acids were too corrosive to both men and equipment and the technique has never gained acceptance in North America.

A standard type of bunker silo where the best results from silage additives are likely to be obtained.

In order to capitalize on the known benefits of additives and eliminate the problem of corrosiveness a number of products have been developed in the form of powders to be applied at the rate of 0.5 kg per metric tonne of fresh forage. The effectiveness of these products is varied and questionable. They can be classified into three categories:

- The sodium salts of acids designed to disassociate quickly when mixed with high moisture grass resulting in a rapid drop in pH.
- Mixtures of enzymes which are supposed to stimulate fermentation and lactic acid production.
- Dried cultures of lactic acid bacteria which under proper conditions stimulate lactic acid production.

Three of these products, one from each category, have recently been tested at Agriculture Canada's Research Station at Agassiz, B.C. These experiments with additives have been conducted within two testing systems. Laboratory silos with a capacity for approximately 2.0 kg of chopped grass have been used to measure the effect of additives on the content of various organic acids in the ensiled product. This experimental system has previously been useful in identifying the effectiveness of such additives as formic acid and formaldehyde in altering the ensiling process. However, the new type of non corrosive additives such as ImPruvAll[1], Nutrigard[2] or NutraLac-SiloAid[3] which have also been tested extensively in this system have not resulted in changes in organic acid content of the silage compared to untreated grass ensiled in similar silos.

1. ImPruAll — Custom Services Inc. 6373 Highway 50, East Carson City, Nev. 89701.
2. Nutrigard — Canadian Distrib. — Pacific Industries Ltd. 970 Malkin Ave., Vancouver.
3. NutraLac-SiloAid — Star-Labs Inc., Missouri, U.S.A.

The second system of testing employs 40 tonne wood-stave upright silos, equipped for measuring temperature change and effluent run-off, followed by feeding trials with lactating cows to evaluate the nutrient content of the silage. The additives ImPruvAll and Nutrigard, the former a mixture designed to increase the acidity of the silage and the latter a mixture of enzymes to stimulate lactic acid formation, were added at the rate of 0.5 kg per tonne to grass at ensiling time. The Orchard grass was ensiled at 24% DM and had an average protein content of 12%. There was no appreciate difference in chemical composition between the silages containing additives and the control silage. The three silages were fed to 15 cows subdivided into three groups and each group fed each silage for a period of 42 days. The results of the feeding trial are summarized in Table 1.

The results of this trial indicated a somewhat higher dry matter intake for the silages with additives compared to the control silage but this was not reflected by an increase in milk yield. Milk yield was higher and bodyweight gain less for the ImPruvAll treated silage compared to the grass treated with Nutrigard. However, efficiency of dry matter utilization favored the control silage over the two treated silages.

A second field trial was carried to test the additive Nutro Lac Silo-Aid which had as its active ingredient a dried culture of lactic acid bacilli. Again the animal response to this additive was measured with lactating cows fed on Orchard grass silage to which the Silo-Aid had been added at ensiling time at the rate of 0.5 kg/tonne. Silo temperatures and rate of run off were greater for the treated compared to the untreated silage even though average dry matter content was 19.4% for both silages when ensiled. The results of the feeding trial are given in Table 2.

There was little difference in animal performance between the treatment groups with the exception of a lower milk yield for cows fed the silage with the additive. The results of the digestibility trial indicated a digestibility of 66% for the complete ration including treated silage compared to 69% for the complete ration fed with the control silage. It appeared from the results of this study that Silo-Aid had a detrimental effect on silage quality.

The results of the studies carried out with silage additives at the Research Station have indicated that the additives tested were of little practical value when proper ensiling procedures were used. Although dry matter intake was improved by the use of the additive ImPruvAll the efficiency of utilization of that dry matter for milk production was less than for the control silage. Nutrigard had no measurable influence on silage quality while Silo-Aid appeared to have a depressing effect on the digestibility of silage dry matter. At the present time it appears that the easy to apply, noncorrosive additives when applied to grass silage have not resulted in the improvement of silage quality previously credited to the application of formic acid or mixtures of formic acid and formaldehyde. However, these products may be of value to the farmer when he has to ensile forages under conditions which are less than optimum.

TABLE 1. THE INFLUENCE OF SILAGE ADDITIVE ON DRY MATTER INTAKE, BODY WEIGHT CHANGE AND MILK YIELD.

Treatment	Dry matter intake (DMI) kg/day	Milk yield kg/day	Body wt gain kg/day	Efficiency kg milk/ kg DMI
ImPruvAll	9.58	29.0	0.53	3.09
Nutrigard	9.67	27.7	0.74	2.99
Control	8.71	28.6	0.77	3.40

TABLE 2. THE INFLUENCE OF SILAGE ADDITIVE ON DRY MATTER INTAKE, MILK YIELD AND FAT PERCENT AND EFFICIENCY OF DRY MATTER UTILIZATION

Treatment	Dry matter intake (DMI) kg/day	Milk yield kg/day	Milk fat %	Efficiency kg milk/ kg DMI
Silo-Aid	10.3	27.7	3.29	2.69
Control	10.4	28.4	3.30	2.73

Dr. Fisher is a nutrition specialist, Agriculture Canada Research Station, Agassiz, B.C.

ASSISTING THE CANADIAN SEED CORN INDUSTRY

M. HUDON

Le programme d'amélioration du maïs grain de la Station de recherches d'Agriculture Canada à Saint-Jean a permis de réaliser une petite industrie florissante pour venir en aide à l'industrie canadienne de production de semence de maïs.

Ce programme d'amélioration et de recherche a pour but de créer des lignées de maïs précoces et résistantes aux insectes et aux maladies. L'entreprise de Saint-Jean consiste à produire massivement des millions d'œufs de la pyrale du maïs qui sont expédiés annuellement à l'industrie ontarienne de production de semence de maïs.

Figure 1. Marcel Hudon

A maize breeding program at Agriculture Canada's research station at St. Jean, Quebec, has produced a thriving sideline that is essential to the Canadian seed corn industry.

The maize breeding research program was designed to develop early maize inbred lines that are resistant to insects and diseases. The sideline is mass producing and shipping, each year, millions of corn borer eggs to Ontario.

A program to develop early maize inbred lines resistant to insects and diseases has operated at the St. Jean research station since 1969 when Canada joined the International cooperative project on the Corn Borer *Ostrinia nubilalis* (Canada Agriculture, Fall 1970). The major objective of the St. Jean program is to develop parental inbred lines that can be used in producing maize hybrids for short season growing areas such as Canada. The project involves screening maize germplasm obtained from all over the world for earliness, resistance to the corn borer and suitability for the creation of synthetic varieties that should logically develop into pure inbred lines. The search is for inbred lines that mature early; resist the corn borer, stalk rot and eyespot organisms, and more recently the northern corn rootworm and have also good agronomic characters and combining ability.

In 1976, members of the Canadian seed corn industry — including King Grain, Ceba-Geigy (Stewart), Pickseed, Pfizer (Warwick), Maple Leaf Mills, and United Cooperatives of Ontario — decided to have their own maize breeding program centered on corn borer resistance. The main purpose of participating in this type of research was to keep the Canadian seed corn industry competitive with that of the United States. A few of the larger U.S. seed companies are able to afford the cost of producing new resistant hybrids. Because of the competitive nature of the commercial seed corn business they tend to keep the background of their hybrids secret, giving them a competitive advantage over smaller seed companies that do not have such a research facility.

To accomplish the new Canadian-based research and development program, each participating company required annually thousands of corn borer egg masses. The St. Jean research station was already producing corn borer eggs for its own

breeding program. Hence, Agriculture Canada and the Canadian seed corn industry agreed that the St. Jean station would produce and sell corn borer eggs to the seed corn companies.

To evaluate resistance to corn borer attack, corn borer eggs are deposited in late June, on corn plants at the whorl stage. The cost of egg masses each of which contains about 20-25 eggs, was originally $40 for 1,000. Due to inflation, the price was increased in 1979 to $45 for 1,000. Each year about 4 million eggs are produced for the St. Jean program, the industry, a few universities and a federal research station (Harrow).

The corn borer is mass reared in three large incubators on a synthetic diet which requires expensive ingredients, time, and manpower to produce. Facilities consist of a diet room where small larvae feed and develop, a moth emergence room where moths are collected by the hundreds each day, and the oviposition room where moths lay their eggs on wax paper. Small paper disks containing an egg mass are cut every morning by an electric machine and shipped to the participating Ontario companies. The largest number of disks obtained in one day was 17,000. The incubation period for eggs is about five days. In the four years that the service has operated, the six seed companies involved have received their eggs in good condition, i.e., unhatched and under good humidity for maximum larval hatching.

Mass-rearing living organism is always a risky undertaking, particularly when the objective is to maximize the production of millions of corn borer eggs with limited growth-

Figure 2. Maize plant having high leaf feeding at the whorl stage indicating its susceptibility to the young corn borer larvae.

Figure 3. Resistant maize line after artificial corn borer infestation.

Figure 4. Susceptible maize line after artificial corn borer infestation.

room equipment. Noxious organisms such as bacteria, fungi, and protozoan parasites are always waiting to strike when their presence is least expected. To minimize the possibility of epidemics during production, some noxious organism inhibitor ingredients are added to the diet.

The financial end of the business is handled by Hybridex, a member of the Canadian seed corn industry in Quebec. Hybridex collects the charges and pays for student salaries and material required for egg production. The project has recently broadened its scope by supplying 40,000 egg masses to a Nebraska seed company in 1978. In 1979, two other American companies have received a few thousand corn borer egg masses from St. Jean. A seed corn firm in northern France has expressed interest in obtaining corn borer egg masses. Shipping eggs by air cargo is expensive but eliminates problems with delivery times.

Insect rearing normally lasts from March to July. High manpower and other costs prohibit all but the larger U.S. firm from setting up their own insect-rearing department. By providing a corn borer egg service at cost, Agriculture Canada is helping the Canadian seed corn industry to stay competitive, without additional cost to the taxpayer.

M. Hudon is senior entomologist at Agriculture Canada's Research Station, St Jean, Quebec.

SHEEP BREEDING YEAR-ROUND

J. A. P. VESELY

Afin de rentabiliser l'élevage du mouton, il importe d'augmenter le taux de reproduction chez les brebis. Pour ce faire, on a entrepris des expériences visant à recréer l'atmosphère propice à la reproduction plus d'une fois par année. L'utilisation d'hormones, dont la quantité nécessaire est difficile à déterminer, ne s'est pas avérée aussi concluante que la modification artificielle de la longueur des jours, par le contrôle de la lumière. Cette dernière méthode a été étudiée selon trois variantes, sur deux types de moutons.

Optimizing lamb production of each ewe is increasingly important to alleviate the ever-rising costs of production. Production can be much improved by fully exploiting all traits. Each year more weight of lamb from each ewe can be achieved

either by getting more lambs from a ewe at each lambing or by more frequent breeding. However, since sheep are seasonal breeders (autumn), the ewes must be induced into a "breeding mood" in the spring. The available means for induction to breeding are hormones, light control, or both.

At the Lethbridge Research Station, three experiments have been conducted, each lasting about four years, to develop a technique that would permit ewes to be induced to breed at any time of the year. Under natural conditions ewes breed only when the daylength is short (autumn and winter). It should be possible to create artificially short days, in the spring and summer, by maintaining the ewes in barns with controlled lighting. Also, it is well known that reproductive processes in animals are controlled by hormones. Therefore, the reproductive cycle in ewes can be altered by specific hormone treatments. Ewes can be stopped or induced to breed.

In the first experiment, controlling the light alone produced almost the same effect as controlling the light and using hormones. As a result, it was decided to study light control alone. In the second experiment, various light treatments were used only in the spring and summer. For the remainder of the year the ewes were maintained under natural conditions. The results were disappointing but it became clear that sheep need a precise rhythm in daylength just as they have under natural conditions. That is, periods of short and long daylength must alternate in a pattern similar to natural conditions. However, instead of the natural 365-day period, a shorter artificial period, for example, 212 or 240 days is used.

The last experiment, which was

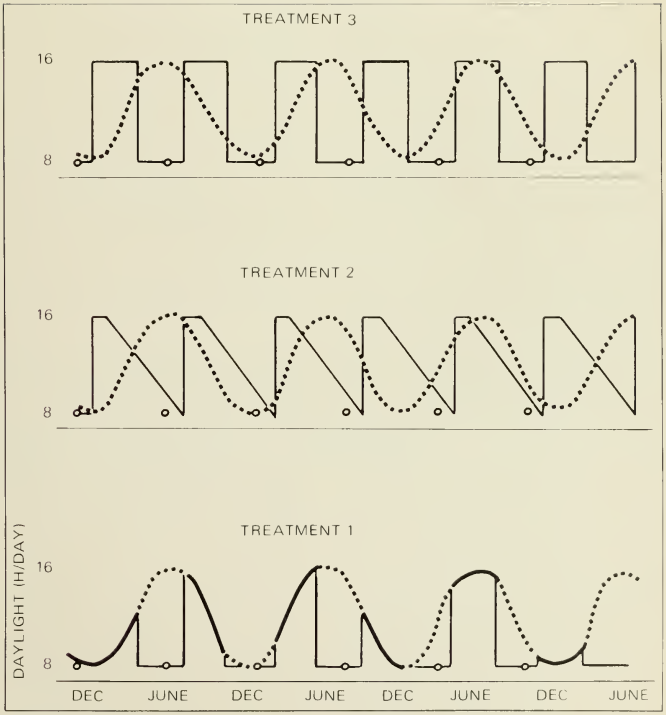


Figure 1. Light treatments for the three modified light regimes (solid line) compared to natural light (dotted line). Circles show start of breeding periods.

recently completed, was carried out in six production cycles of 212 days each over 3½ years. Rambouillet and Suffolk ewes were arranged in four groups of 15 ewes of each breed. A control group of each breed was maintained continually under natural daylight conditions but were exposed to rams every 212 days as were ewes under the light treatment. Ewes on Treatment 1 were maintained under natural daylight conditions with periods of reduced daylight (8 hours a day) for 106 days starting about 65 days before breeding. For the group of ewes on treatment 2, about 10 days after breeding when daylength was 8 hours a day, the daylength was abruptly increased to 16 hours. This level was maintained for 42 days and then gradually reduced by 21 minutes a week for 160 days. At the end of this period, the breeding was terminated. The group of ewes on treatment 3 was exposed for 106 days to increased daylength of 16 hours a day. Daylength was then reduced 8 hours also for 106 days. Breeding started on the 65th day of the reduced daylength. The light pattern described for each treatment was repeated every 7 months. All treatments are graphically depicted in Figure 1. Rams were not under any light treatment.

The most significant progress achieved in this experiment, compared to the two previous experiments, was the positive response of the Suffolk ewes to some of the treatments (Table 1, cycles 2, 4, and 5). In the previous experiments, because the Suffolk ewes exhibited lack of breeding desire when out-of-season, it was concluded that Suffolk were less sensitive than Rambouillet for induction to breeding in the spring or early summer and therefore probably were unsuitable for year-round breeding. The latest results suggest that any breed might be induced to breeding if the correct treatment for each breed is applied.

TABLE 1. SUMMARY OF CONCEPTION RATES OF RAMBOUILLET AND SUFFOLK EWES IN SIX 212-DAY PRODUCTION CYCLES UNDER DAYLIGHT CONDITIONS OR THREE LIGHT TREATMENTS

Production cycle	Date of breeding	Breed	Conception rates (%)			
			Control	Treatment		
				1	2	3
1	Nov. 1-Dec. 2	Rambouillet	92	79	100	87
		Suffolk	91	85	92	67
2	June 2-July 4	Rambouillet	23	75	85	85
		Suffolk	0	17	67	56
3	Jan. 1-Feb. 2	Rambouillet	85	100	64	93
		Suffolk	80	77	85	78
4	July 30-Sep. 1	Rambouillet	71	71	42	46
		Suffolk	42	82	64	70
5	Mar. 1-Apr. 3	Rambouillet	80	75	100	82
		Suffolk	57	55	85	85
6	Oct. 2-Nov. 3	Rambouillet	71	85	64	100
		Suffolk	86	93	71	80

Prolificacy, expressed by the number of lambs born per 100 ewes lambing, was significantly affected by treatment (Table 2). Treatment 3 gave significantly higher prolificacy than control or treatments 1 and 2. Lamb production, expressed as the number of lambs produced per 100 ewes exposed to rams, under treatments 2 and 3 was higher than that of the control ewes. Ewes on treatment 3 also had higher lamb production than those on treatment 1. These results give conclusive evidence that light control regimes can significantly improve lamb production over the conventional system of production. When the results in Table 1 were recalculated on an annual basis, the Rambouillet control ewes produced 179 lambs per 100 ewes exposed to rams, for Suffolk the figure was 174. Corresponding values for treatment 1 were Rambouillet 200 and Suffolk 197; for treatment 2, the figures were 193 and 226; and for treatment 3, 223 and 242.

TABLE 2. CONCEPTION RATES, PROLIFICACY (NUMBER OF LAMBS BORN PER 100 EWES LAMBING) AND LAMB PRODUCTION (NUMBER OF LAMBS PER 100 EWES EXPOSED TO RAMS) IN SIX 212-DAY PRODUCTION CYCLES UNDER NATURAL DAYLIGHT CONDITIONS AND THREE LIGHT TREATMENTS

Treatment	Conception (%)	Prolificacy	Lamb production
Control	65	153	100
1	73	147	107
2	75	158	120
3	76	173	131

These results are encouraging suggesting that application of light

control will be feasible for commercial operations. The achieved level of annual production of 242 lambs from 100 ewes exposed to rams in the last experiment on treatment 3 is a great step forward. It must be emphasized that, apart from the necessary conditions for light control such as windowless barns with proper ventilation, the management did not differ in any way from that of an average commercial operation. All animals in the last experiment were born and maintained under total confinement. During the 12 years of these experiments, no drastic nutritional or disease problems have been experienced. It is believed that further progress can be achieved by better controls in management that would still be practical and acceptable by a commercial producer.

Manipulation of daylength must be viewed as the best alternative for frequent breeding of ewes. It can give immediate economic gains as opposed to selection and development of strains that would breed year-round. From the standpoint of environmental pollution, it is safer than hormones for induction of "breeding mood."

J. A. P. Vesely is an Animal Geneticist at Agriculture Canada's Research Station, Lethbridge, Alberta.

SOME CONTEMPORARY ISSUES CONCERNING MEAT AND POULTRY PRODUCTS

J. McGOWAN

Agriculture Canada requiert la coopération de l'industrie dans sa tâche de contrôler les maladies, aussi bien dans l'élevage que dans l'abattage du bétail et de la volaille destinés à la consommation. C'est grâce aux programmes gouvernementaux et à la vigilance de l'industrie qu'on peut en arriver à assurer des produits sains.

Les programmes d'Agriculture Canada comprennent l'inspection quotidienne des usines de traitement des viandes et de la volaille, cinq groupes de travail qui sont prêts à réagir sans délai dans le cas du déclenchement de toute nouvelle maladie et des programmes spéciaux en vue d'éliminer des maladies telles la brucellose ou la salmonella.

Dans le contrôle des maladies, il importe de mesurer l'étendue des risques et de réagir en conséquence tout en tenant compte des moyens financiers disponibles. On ne dispose pas d'assez d'argent pour garantir l'absence de tout risque. Il est donc nécessaire de faire les choix les plus pertinents.

As we move on to the 1980s, there will be a continuing need in Canada for effective government programs as well as industry alertness and co-operation to ensure a safe and wholesome food supply for the consumer. As a government we spend many millions annually on regulation and control in this field. Much of the budget and the workload is vested in the Food Production and Inspection Branch of Agriculture Canada, where a staff of several hundred use a variety of methods and approaches to achieve their goals.

Canadians depend upon these people to do the job but many others in government and outside must work together to achieve success. Our national experience with the cattle disease, brucellosis, illustrates the need for and the nature of this co-operative effort.

In the early 1970's brucellosis made a comeback of crisis proportions. Among its many economic side-effects at its peak was the disruption of our export trade in dairy breeding cattle. The picture has changed markedly from 1977 when

at one point there were almost 1,500 herds under brucellosis quarantine in the country. Totals now are in the few hundreds.

Moreover, our coastal provinces are now brucellosis-free and it has been our long-standing intention to eradicate the disease from cattle by 1984. The cost of eradication is high but the alternative is even more costly in terms of lost markets, declining milk production, breeding loss through abortions and so on.

The main point is that government-sponsored test-and-slaughter and movement control programs, in co-operation with the people directly affected by a disease like brucellosis, *can work* to achieve a particular goal — in this case, eradication. In future we will try not to be caught by surprise by brucellosis or any other disease of animals or poultry, whether homegrown or imported.

For example, five emergency task forces have been established, made up of our own staff throughout the country, to cope with any surprise outbreak of a foreign disease. If a poultry disease such as virulent Newcastle shows up in this country, one or more of our task forces will go into action to contain and eliminate it. A foreign disease outbreak has not been experienced since bluetongue in British Columbia in 1976. The current task force system grew out of our successful ad hoc response to that problem.

It has been a time-consuming effort to set up task forces, and the work will continue in order to improve their effectiveness in the delicate task of averting catastrophe. It takes little imagination for anyone to consider the terrible effects of a large-scale outbreak of either virulent Newcastle or indeed fowl plague. These high-mortality and highly-contagious diseases obviously could create havoc in the poultry industry if allowed to return to this country.

A veterinarian on the staff of the Food Production and Inspection Branch of Agriculture Canada checks for signs of disease in poultry.

Hatchery employee transfers newly-arrived eggs from their crates to a setting tray with the help of a vacuum lift to avoid touching by hand as a sanitary precaution.

In 1979, Newcastle was detected in imported pet birds in several states in the United States, therefore, complacency is unwarranted. Canada's now-declining brucellosis problem underlined the folly of complacency. The consequences of such complacency can be written in terms of millions of dollars in compensation paid for slaughter of animals, millions in lost markets, and uncountable private loss. The numbers associated with any failure by society to do its disease-control job are almost too high to contemplate.

It has been demonstrated what collective action can accomplish with brucellosis eradication. Similar results are being sought in salmonella control in the poultry industry. There must be 2,000 different salmonella types; therefore, prospects of complete salmonella eradication in the poultry chain from producer to market does not appear feasible. But improved performance in salmonella control as a government and as an industry is essential.

Canadians can be pleased at the overall high level of sanitation in our Canadian hatcheries, particularly in the control of salmonella bacteria. It is one of the many reasons why the Canadian poultry population is among the healthiest in the world.

Nonetheless salmonella remains a problem. Concern with it is not so much that the strains being dealt with now are simply a disease of poultry. Rather, these strains are a disease of people, who catch it somewhere in the process from the laying of the egg to the ultimate consumer. In one 1978 case, some hundreds of people in one area of Canada came down with salmonellosis traced to one point of origin. Salmonella as we know it today is not normally a killer of people.

In any event, we've managed virtually to rid ourselves of salmonella pullorum. So, the problem, in essence, is dealing with the milder types that cling to chicks and eggs and equipment and are found in feed and inside the birds themselves. Employees inside poultry plants and hatcheries can carry the bacteria to the outside world to our collective disadvantage.

How do we sharply reduce the salmonella presence? Is it indeed

possible? One study indicated that plastic crates used to transport broilers to a processing plant, despite washing after each use, could be a salmonella carrier. That is one problem of salmonella control, but there are many others. For example, it is not easy to guard against salmonella which may or may not, be in or on the many millions of eggs bought each year from suppliers outside Canada by Canadian hatcheries. Control on a product from the outside tends to be more difficult than an exclusively domestic operation involving the same numbers.

One recent study showed that half of all fresh whole eviscerated broiler chicken carcasses from federally-inspected poultry processing plants had some salmonella contamination. One has the impression, from the level of official concern about salmonella, that it is important first of all to do something about it, and second, if salmonella levels cannot be appreciably diminished, tighter regulations should be considered to achieve this goal. It is far better for government and private industry to work together as we are now doing, to deal with the problem *without regulations*. But if tighter regulations are *eventually* deemed necessary, they should perhaps arise as a result of these *joint consultations* as in the case of brucellosis.

As a government and as an industry, we should not let our current preoccupation with salmonella divert us from other diseases hovering in the background, with some landing from time to time to our mutual disadvantage. We seem to be doing quite well in the control of Marek's disease, a severe economic problem in the 1960s in poultry. Canada licensed Marek's vaccine to combat this disease some months before a similar vaccine was commercially available in the United States. The vaccine used in Canada as a control device is a good vaccine. If there are failures in vaccinated flocks, the problem is probably not the vaccine, but how efficiently it was administered.

Veterinarian checks cow for signs of brucellosis, a cattle disease which the Health of Animals Branch of Agriculture Canada is attempting to eradicate. Brucellosis incidence is well down now from the incidence peaks of a few years ago.

Another poultry disease is infectious laryngo tracheitis or ILT. We have looked at it carefully in terms of threat to the poultry industry. ILT remains in the country in isolated pockets but lacks the devastating medical effects on birds that Newcastle or fowl plague have. It's difficult to eradicate ILT completely from the bird population, partly because it is so easily and persistently carried. The branch has concluded that complete eradication would be an overly-costly program, as well as being disruptive to the industry in certain parts of the country because of slaughter and quarantine. For the time being we are content to keep the disease well under control rather than take more dramatic and drastic steps.

Another branch program is to federally regulate the handling of meat produced by the natural or disease-induced death of livestock. Much of this so-called "dead meat" goes into pet food and the branch has an obligation to ensure that there is no chance of any of it getting into the human food chain. The kind of control envisaged won't be excessively tight. But it will be tight enough to allow us to keep enough of a handle on dead meat to see that diseases such as anthrax aren't passed around as readily and to ensure that pet food is of sufficient quality and

cleanliness. This is probably something that should have been done sooner.

In the swine industry, we had an intensive on-the-spot look at the 80-or-so operations around the country that collect and use garbage to fatten pigs. It is possible that the remains of a piece of illegal fresh meat brought into the country by an immigrant could end up in the stomach of a Canadian pig through a garbage feeder. If that piece of meat was perhaps pork from a foreign pig infected with African swine fever, it could touch off an epidemic in Canada and put the branch into a task force situation. The last thing the country needs right now is an African swine fever outbreak.

There is concern about the effectiveness of regulations on garbage feeders even though the number of garbage feeders has declined in recent years. It is important to ensure, to the highest degree possible, that garbage feeding presents no serious disease threat to the swine industry. As in many areas of disease control, we must measure the risk and react accordingly within our economic means. At the same time we must be extremely careful not to over-react to small-risk situations. There is only so much money to go around in disease control and we cannot normally seek absolute guarantees because the economic cost is too great.

In this human high-travel era, African swine fever is also a seasoned traveller. It has leaped the Atlantic from Europe and is as close to us now as Haiti and the Dominican Republic. Canada is following the boy scout motto of being prepared. If we are prepared enough, in this and other fields, we will be doing our job. In the same vein, we are pondering the advisability of stockpiling vaccine against foot-and-mouth disease, which was eradicated from Canadian livestock at huge cost in the 1950s. If there is another outbreak in Canada, vaccine should be available elsewhere but having a supply of our own is much better.

One important comfort in the official struggle to maintain a safe and wholesome food supply is the knowledge that government employees are sharing the responsibility with dedicated people in the agriculture industry.

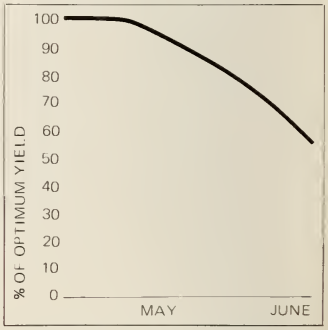
An edited version of a speech presented to the 1979 annual meeting of The Canadian Hatchery Association by DR. J. McGOWAN, Assistant Deputy Minister, Food Production and Inspection Branch, Agriculture Canada.

WEATHER AND FARM FIELD WORK

J. A. DYER and
W. BAIER

Les agrométéorologistes d'Agriculture Canada ont mené de nombreuses études pour aider les agriculteurs à planifier leur travail, ainsi que ceux qui fournissent des services-conseils aux producteurs en matière de météorologie.

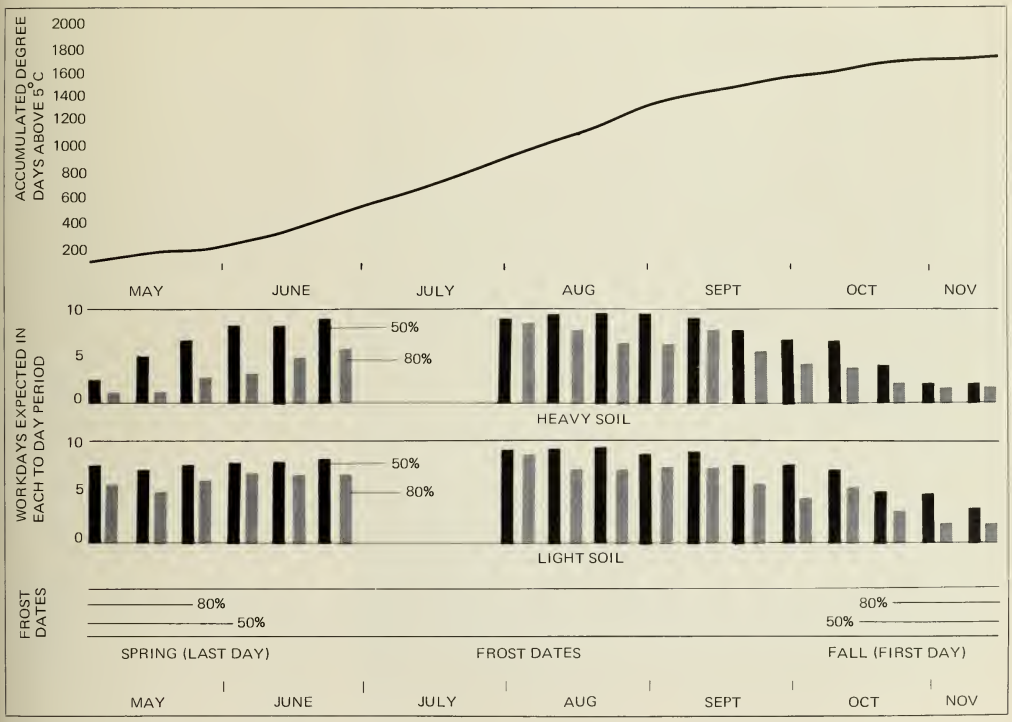
On a conçu un certain nombre de modèles de simulation, basés sur les données relatives à la température, enregistrées par le passé. Cette information est ensuite ajoutée à d'autres facteurs climatiques en vue d'en arriver à établir une planification régionale.



Yield depression in grain corn (maize) as a function of the planting date, based on data from Guelph University , Guelph, Ontario.

Farm planning is an essential part of modern agriculture. The timely completion of various field tasks, which are weather sensitive, and the consequent minimization of crop losses (chart 1) is a major aspect of farm planning. Agrometeorologists of Agriculture Canada have completed a number of studies to aid farmers to plan their field operations.

For many farm operations the available work time can be estimated by observing the work schedule of farmers. It is difficult to relate



The growing season at Kentville, N.S., defined by the risk of frost (0°C) and availability of workdays (on light and heavy soil) at both 50% and 80% certainty and the average degree days above 5°C, based on historical weather records.

these operations to other farms, geographic regions or climates. In providing guidelines for weather related farm planning, the need is to determine for a particular region how often favorable weather conditions occur for doing a specific field task at a specific time of the year. To do this the combination of weather events that cause unfavorable work conditions must be understood. Agrometeorologists have developed a variety of simple weather based simulation models for a number of different types of operations. These models are then applied to historical weather records to obtain useful planning information.

For planning purposes, no circumstances related to weather can be anticipated with absolute certainty. Mean weather conditions, such as average rainfall or the average rate of occurrence of some minimum amount of rainfall, is inadequate information for planning because such conditions are met only one half of the time. Therefore, the climate analysis must include information on the degree of risk in each field task. In general, the level of risk on which the farm plan is based must provide enough profit in good years so that losses sustained during unfavorable years are compensated. When prevention of losses is possible, planning should be such that the cost of prevention does not exceed the value of the losses over a number of years. In this type of planning risk is related to the number of projected years which, on average, result in one year's loss. For example, irrigation may be a good practice where drought can be expected one year in two, but not worthwhile in regions that suffer drought one year in five. Since risk is related to climatic variability, methods of studying variability are a major concern.

The most timely field tasks involve either planting or harvesting. For planting the soil must be firm enough to support machinery traffic and warm enough to allow seed germination. Both conditions depend upon near-surface moisture. For harvesting the crop must be dry enough for handling and storage and the soil must be trafficable. For planning purposes, both cases require soil moisture estimates. Harvesting is specific to each crop. It is much more difficult to provide general information for harvesting than for planting. It is possible to do a general study of just field trafficability in the fall, since the type of plant cover has little to do with dryness of the soil at harvest time.

Agriculture planners and extension workers have been provided with much of this type of historical weather analysis in recent years. A general study of field trafficability in spring has been completed for selected sites across Canada[1]. The role of these data in selecting optimum tractor size was outlined in a previous issue of Canada Agriculture (winter 1978). Several studies have been done, or are in progress, for determining plant tissue dryness in specific crops, on a regional basis. Such efforts are often done by, or in co-operation with, provincial agencies. These include a detailed risk analysis of conditions for field drying hay in Ontario[2]. Grain drying conditions have been studied and risk analysis information is available for the Maritime grain growing region[3]. Future work will include a study of potato harvesting conditions in the Atlantic Region and a Canada-wide analysis of weather risk in field cured hay and of fall field trafficability.

Although these timeliness studies may be used directly in farm planning they are useful in conjunction with other available agroclimatic information. For instance, degree days, as a measure of the heat available for crop growth, may not be reliable unless other factors are also considered since heat accumulates at a significant rate before and after the true growing season. That is, before spring planting is completed and after harvest begins, because of risk of frost or lack of field trafficability (Chart 2). This is particularly true on heavy soils. Frost dates, frost free season lengths and crop maturity dates have all been mapped. and are available in an Agroclimatic Atlas for Canada. Unfortunately good growing conditions and adequate conditions for field work do not always occur together. In areas where field trafficability is not usually a major restriction, drought may be a serious problem. Therefore, field work-time studies are now being integrated with many other types of weather related information.

Mr. Dyer and Dr. Baier are with Agriculture Canada's Agrometeorologist Section Land Resources Institute in Ottawa.

[1]Tech. Bulletin 86, Agrometeorology Section, Research Branch, Agriculture Canada.

[2]Tech. Memo 77-1, Land Resource Science, University of Guelph.

[3]Misc. Bulletin 12, Agrometeorology Section, Research Branch, Agriculture Canada.

HALF CENTURY OF FOOD PROCESSING RESEARCH AND DEVELOPMENT AT SUMMERLAND

J. A. KITSON

Le premier laboratoire de recherches sur le traitement des aliments d'Agriculture Canada a été créé il y a cinquante ans déjà, à Summerland, C.-B. On y a consacré beaucoup de temps à la recherche de moyens d'utiliser les pommes et les fruits à noyau, impropres à la mise en marché. Maintenant, on se penche principalement sur l'équipement et les techniques de transformation et sur l'amélioration des produits alimentaires. On y offre également divers services d'aide à l'industrie des fruits.

Dr. Dugal MacGregor and Lance Brown test a new steam blancher at Summerland Research Station.

Fifty years have passed since the day in June 1929 when F. E. (Ted) Atkinson joined the staff at Summerland Research Station to start CDA's first food processing research laboratory. In the intervening years the group of food technologists founded by Atkinson and led by him for 36 years have worked closely with commercial fruit and vegetable processors across Canada and around the world to develop numerous new processes, new products and new designs of processing equipment.

During its first quarter century the food technologists at Summerland were concerned with developing economically feasible uses for unmarketable surpluses of apples and stone fruits such as sweet cherries, apricots and peaches. Important developments included a rapid automated process for candying cherries, processes for manufacturing vitaminized apple juice and canned fruit pie fillings. In addition assistance was provided in the establishment of a large number of small processing plants in British Columbia. During the 1939-1945 war the staff's knowledge of dehydrated fruits and vegetables was used to help feed the military and civilian populations in Great Britain.

The Food Processing Section staff was increased to its present size in 1957 with the amalgamation of the Department's Experimental Farms and Science Services to form the Research Branch. Four research scientists and five technicians now comprise the full time staff along with an additional half time technician and the part time service of two agricultural engineers and a student assistant.

The original direction of the section's program has been changed slightly in recent years, although the problem of utilizing surpluses is still important. Today there is greater emphasis on increasing plant efficiency through mechanization, on minimizing waste output, utilizing waste materials and on improving quality and nutritive value of products through development of better

processing methods.

In the development of processing techniques and equipment the following ideas are in various stages of development and testing:

- a continuous system for sterilizing fruit products in flexible pouches without use of high pressure retorts.
- a shaker mechanism for rapid sterilizing and cooling of 100 oz. cans of viscous low acid foods such as cream style corn.
- a blancher, for use in vegetable canning or freezing plants, that is intended to eliminate all dilute effluent by producing a concentrated molasses-like liquid that has potential as a feed additive.
- an improved type of tray drier designed specifically for preparation of fruit "leather" from fruit purees.
- an automatic aligner for asparagus spears, capable of sorting randomly aligned spears into two groups with tips and butts all pointed the same way in each group.
- a process for removing bitterness and green pigments from juice recovered from celery leaves and trimmings or other vegetable wastes.
- a method for producing dry fruit snacks similar to conventional dry fruit by combining low moisture dry fruit flakes and fruit juice.

In regard to the development of new or improved food products, product developments currently under test include:

- Processed fruit products in flexible containers.
- an assortment of compressed freeze dried foods for survival ration packs for aircraft, lifeboat or military use.
- vegetable juice blends using decolorized debittered celery juice.
- breads with added fiber content derived from apple pomace.

Improvement in winemaking processes and evaluation of new grape selections for wines and juices is another important area of activity.

J. A. Kitson, Head of the Process Development Section, observes a can shaker in operation at Summerland.

Approximately 150 hybrid grapes with character similar to European wine grapes (vinifera) are being evaluated for use in making high quality table wines. A number of the selections under test have come from the Station's own grape breeding program and some are also being tested for use as unfermented juice.

Research in winemaking technology is also underway. Among the objectives are improvement of wine aroma and flavor by preventing aroma losses during fermentation and by reducing excessive acidity. Prevention of spoilage in bulk packed wines in flexible containers is also being investigated as are improvements in sherry production.

In addition to research and development the section provides a wide range of technical assistance to industry. Services have included aid in designing equipment layouts, design of waste treatment and/or utilization systems, assessment of heat distribution in steam retorts and of heat transfer rates in canned and frozen foods, solution of food spoilage problems, advice on processing methods for a wide range of both temperate zone and tropical fruits and vegetables.

Over the past 25 years staff members have visited and provided technical advice to food processing firms in more than twenty-five countries in Europe, Asia, Africa, Australia and North and South America. While much of this advice is on advanced technology the staff also have a valuable knowledge of "appropriate technolcgy", for developing countries; simple methods of food processing that can be started up at low cost using largely locally built equipment and employing a substantial local labor force.

In addition the section has provided training at Summerland in various facets of processing technology to food processors from a number of developing countries.

Mr. Kitson M.S. is Head of Engineering new Products at Canada Agriculture, Summerland, B.C. Research Station.

ECHOES
FROM THE FIELD AND LAB

ECHOS
DES LABOS ET D'AILLEURS

MANURE AN ECONOMICAL ALTERNATIVE Rising resource costs are prompting many livestock farmers to take a second look at fertilizing with manure.

Charlie Crober, a fertilizer specialist with Agriculture Canada's plant products division in Ottawa, says the steadily increasing costs of commercial fertilizers is making manure an economic alternative for farmers with livestock.

At today's prices, the commercial fertilizer equivalent value of 18 tonnes of cattle manure would be about $50. Eighteen tonnes may sound like a lot, but Mr. Crober says it takes only three dairy cattle to produce that much in a year.

That 18 tonnes of manure contains the equivalent of 45 kg of nitrogen, 19 kg of phosphorus and 81 kg of potash. The high nutrient value of manure is the result of the animals using only about 25 percent of the nutrients in their feed. The other 75 percent is available in the manure.

Besides the three major plant nutrients, manure also contains quantities of trace elements needed by many plants for normal development.

Manure application also improves soil fertility and tilth, something commercial fertilizers cannot do.

Unlike most commercial fertilizers, not all the nutrient value of manure is available to plants during the first crop year. Some is carried over into the succeeding year.

Manure must be stored and applied properly to be useful. Manure should be stored so that nutrients do not wash away when exposed to rains.

Before applying any manure or commercial fertilizer, a farmer should have his soil tested to determine exact needs. If too little is applied, the crops will not grow normally. If too much, the excess nutrients will leach out and pollute nearby waters, as well as waste the farmer's money.

RENEWABLE PROPERTIES OF SOIL The depletion of topsoil by wind and water is a constant problem in many areas. Some methods that farmers use to reduce soil erosion include strip farming, trash cover and grassing of water runways.

A question that is often asked after the topsoil has been eroded is whether or not it is possible to reclaim that land while continuing to plant crops, and if so, how long will it take?

Researchers at Agriculture Canada's Lethbridge Research Station are evaluating the changes that occur in the soil's organic matter on dry land where cereals alone, or rotated with a legume were grown on land that had lost its topsoil by erosion. Despite green manuring and added fertilizer, the organic matter content of the upper 15cm of the soil decreased after five wheat-fallow cycles. However, the fraction of organic matter thought to be necessary in forming soil aggregates increased. An increase in soil aggregates will help to reduce further wind and water erosion.

Dr. J. F. Dormaar, the soil chemist at Lethbridge, says that based on 10 years of field trials with cereals and legumes under cultivation, it appears that good soil once lost is slowly renewable. Other practices such as permanent pasture would lead to more rapid results.

NEW RED CLOVER VARIETY The new variety, Bytown, was developed at the federal department's Ottawa Research Station. It is the first of a new type of red clover cultivar, called a tetraploid, to be produced in Canada. Tetraploid cultivars are the result of doubling the chromosome number of normal red clover varieties.

Bytown was produced by doubling the chromosome number of the popular red clover variety, Ottawa. Many tetraploid varieties have been recommended in Europe because of greater yield and longer life than the parent varieties.

Bytown is recommended for use in northern Ontario because it continues to produce in the third year after planting. Red clover varieties now in use in this area give disappointing yields after the second year. A similar situation occurs in northern Quebec.

There has been an increased use of red clover haylage in northern Ontario in support of the dairy industry.

Bytown is taller, with larger leaves and stems than Ottawa. It also out-yielded Ottawa in tests carried out in northern Ontario.

NEW OAT VARIETY LICENSED A new cultivar, particularly adapted to the black and grey soil areas of Alberta, has been licensed by Agriculture Canada.

The new variety, Cascade, is an extremely high yielding cultivar developed at Agriculture Canada's Lacombe, Alta. Research Station.

In four years of tests, Cascade outyielded all cultivars with which it was compared. On average Cascade exceeded Grizzly by 9.4%, Harmon by 18.3% and Random by 11.7%.

Cascade is three to four days earlier maturing than Grizzly, has better lodging resistance, and similar kernel weight and plant height. In central Alberta the maturity of Cascade is similar to Random.

Cascade has performed well in other areas of the prairies, but it is susceptible to stem and crown rust and is not recommended for the eastern prairies.

FEEDING BEEF COWS AND HEIFERS A recent Agriculture Canada publication on feeding beef cows and heifers stresses the importance of proper feeding to obtain the best results from available feedstuff. Attention in feeding is said to be paramount in obtaining the best financial returns from a beef cow-calf operation.

Starting from the premise that beef cows are maintained to produce calves, the authors stress that feed costs can reach 65% of the total cost of producing calves. To keep costs down the beef producer must efficiently use the feedstuff he has available. Efficient use of feed requires that the producer recognizes and satisfies the varying nutrient requirement of the cow or heifer throughout the production cycle.

The authors, D. M. Bowden and R. Hironaka, Agriculture Canada Research Station, Lethbridge; P. J. Martin, Alberta Department of Agriculture, Edmonton; and B. A. Young, University of Alberta, Edmonton point out that although feeding is important, the success of a beef producer depends upon attention to all aspects of management.

The publication covers in detail the nutritional requirements of producing cows throughout the production cycle. Energy factors are itemized, including the energy content of feedstuffs, energy loss through various body functions, and the net energy available to the animal for maintenance and production.

The effect of winter climate on energy requirements under different circumstances is also emphasized as is the special nutritional requirements of pregnant cows and heifers. Finally, sections on fall calving and the creep feeding of calves are included.

LIVESTOCK METRICATION Canada Agriculture Volume 24 No. 3 reported in this section that the beef Record of Performance (R.O.P.) would convert to metric on January 1, 1980. The date for metric conversion has been postponed.

Love Printing Service Limited
Contract No. 10KT 01927-8-10048

© Minister of Supply and Services Canada 1980
© Ministre des Approvisionnements et Services Canada 1980

Agriculture
Canada